

# UNCLASSIFIED

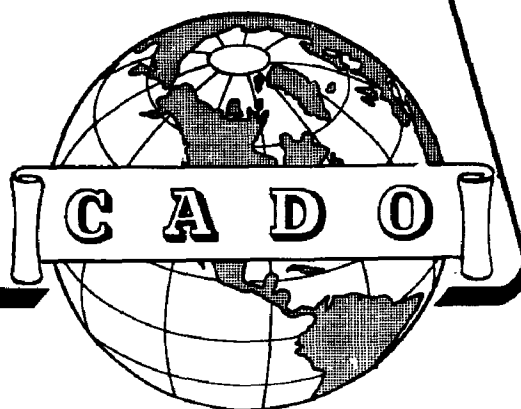
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49160

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Control Surfaces - Elevator Hinge Bracket - Sta. 7 - Static Test - Date of  
Test 16 and 28 July 1945 - Model XB-36

Wright, W. E.

Consolidated Vultee Aircraft Corp., Fort Worth Division, Texas  
(Same)

49160

(None)

FSG-196

-(Same)

Oct '45    Unclass.    U.S.    English    14    photos, drwgs

Tests were made to determine the ability of an elevator hinge bracket in the XB-36 bomber, at station 7 with hinge line at 28.5% of the elevator chord, to withstand the design ultimate load. Two test specimens were fabricated and tested. Specimen 36T669-2 consisted of two 0095 gage 3-in. 25ST tubes, two 36T671-7 magnesium fork end fittings, and one 36T670 adjustable elevator hinge fitting, also made of magnesium. Specimen 36T669-0 consisted of two .083 gage 3-in. X4130 steel tubes, two 36T671-6 magnesium fork end fittings, one 36T670 adjustable elevator hinge fitting, also made of magnesium, and a dummy steel lock bracket. Both elevator hinge brackets exceeded the design ultimate load for the conditions tested and are considered structurally satisfactory.

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Structures (7)  
Design and Details (3)

(25900.3); XB-36 (99409)

Control surfaces - Structural tests

(1)

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FSG-196

Control Surfaces - Elevator  
Hinge Bracket - Sta. 27 - Static  
Test dated Oct. 30, 1945

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CONSOLIDATED VULTEE AIRCRAFT CORPORATION  
FORT WORTH DIVISION • FORT WORTH 1, TEXAS



**Test #F-1451**

MODEL XB-36

REPORT FSQ-196

DATE. October 30, 1945

**TITLE**

CONTROL SURFACES - ELEVATOR HINGE BRACKET -

### STA. 7 - STATIC TEST

The test described in this report was conducted between 7-16 & 7-28-45.

PREPARED BY: W. E. WRIGHT

GROUP: Engineering Laboratory

**REFERENCE:**

**CHECKED BY:**

**APPROVED BY:**

NO. OF PAGES 13

**APPROVED BY:**

NO. OF DIAGRAMS 9

for L.B. Robbins

## REVISIONS

[illegible]

ANALYSIS \_\_\_\_\_  
PREPARED BY \_\_\_\_\_  
CHECKED BY \_\_\_\_\_  
REVISED BY \_\_\_\_\_

Consolidated Vultee Aircraft Corporation  
FORT WORTH DIVISION  
FORT WORTH, TEXAS

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REPORT NO. FSC-196  
MODEL XB-36 F-1451  
DATE October 30, 1945

CONTROL SURFACES - ELEVATOR HINGE BRACKET -  
STA. 7 - STATIC TEST

REFERENCES:

- (1) C.V.A.C. Drawings  
36T669 - Elevator Hinge Bracket  
36T670  
36T671 - Fittings, Elevator Hinge bracket
- (2) Preliminary Stress Analysis, XB-36 Horizontal Tail

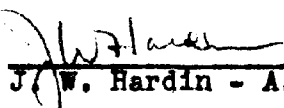
PURPOSE: To fulfill commitment made to the A.T.S.C. by C.V.A.C. letter 22352 - FW # 1591, concerning the ability of a typical elevator hinge bracket, at station 7 (133) with hinge line at 28.5 % of the elevator chord, to withstand the design ultimate load.

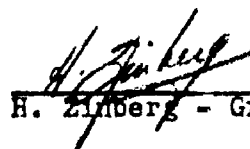
SUMMARY: Specimen 36T669-2 was tested for the hinge load condition only. The bracket supported the design ultimate load of 11,630 # without distress; end fitting 36T671 failed in tension at the net section under a hinge load of 12,700 #, 109 % of the design ultimate load of 11,630 #.


Specimen 36T669-0 was tested for the combined hinge and lock load condition. The bracket supported the design ultimate load with no indications of distortion and withstood 212 % of the design ultimate lock loads of 4,470 # up at the hinge and 8,210 # down at the lock fitting. Since the specimen did not fail under the 212 % load, the bracket was subjected to the hinge loading condition. The test resulted in failure at a load of 13,500 #, and was identical to the failure of specimen 36T669-2.

Both elevator hinge brackets exceeded the design ultimate load for the conditions tested and are considered structurally satisfactory.

WITNESSES:

  
J. W. Hardin - A.A.F.

  
H. Zimberg - Group Engr.

  
J. W. Johnson - Stress Anal.

ANALYSIS \_\_\_\_\_  
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MODEL XB-36 F-1451  
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CONTROL SURFACES - ELEVATOR HINGE BRACKET -

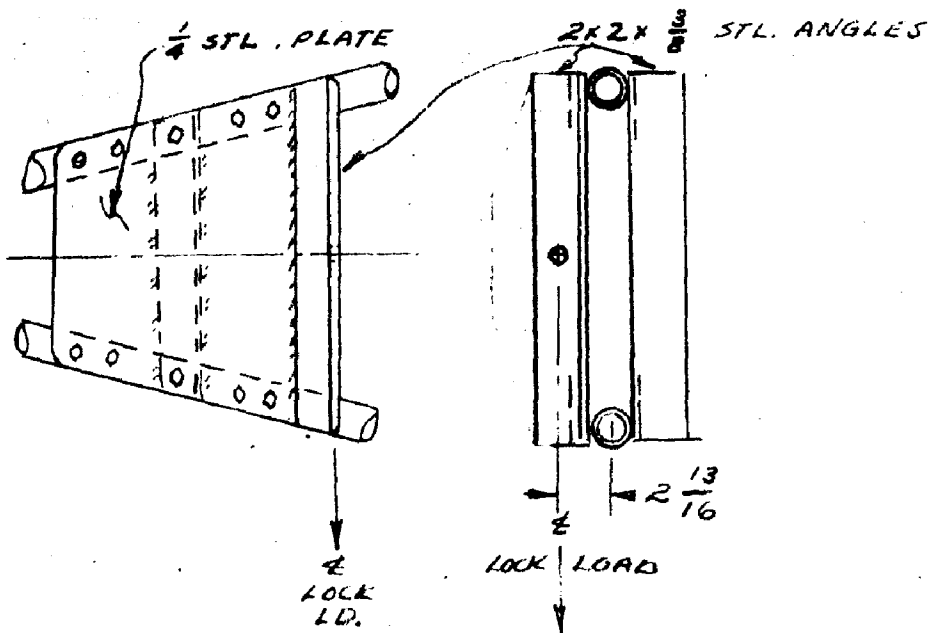
STA. 7 - STATIC TEST

**OBJECT:** To determine the ability of the elevator hinge bracket at Station 7 (133) with the hinge line at 28.5 % of the elevator chord to withstand the design ultimate load encountered in low angle of attack (most aft c.g.) and locked (ground loads) conditions.

**DESCRIPTION OF SPECIMEN:** Two specimens were fabricated in accordance with C.V.A.C. drawing 36T669, shown in detail in Figure 1. Specimen 36T669-2 consisted of two .095 gage 3" 24ST tubes, two 36T671-7 magnesium fork end fittings, and one 36T670 adjustable elevator hinge fitting, also made of magnesium. The bracket was assembled with the hinge line at 28.5 % of the elevator chord.

Specimen 36T669-0 consisted of two .083 gage 3" X4130 steel tubes, two 36T671-6 magnesium fork end fittings, one 36T670 adjustable elevator hinge fitting, also made of magnesium, and a dummy steel lock bracket. The bracket was assembled with the hinge line at 28.5 % of the elevator chord.

The lock mechanism was not available but was simulated by a steel bracket as shown below:



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**TEST SET-UP AND PROCEDURE:** Specimen 36T669-2 was tested for the down load condition as shown in Figures 2 and 3. The lateral support offered by the elevator and stabilizer was simulated by restraining the side movement of the load column which received the thrust of a 12 ton calibrated hydraulic jack. A dial gage was set up to check the lateral movement of the column, if any.

Specimen 36T669-0 was tested for the combined hinge and lock load condition as shown in Figures 2, 6 & 7. By means of a loading beam the thrust of the 12 ton calibrated hydraulic jack supplied a down load at the lock bracket and an up load at the hinge point. Lateral support at the hinge point was provided in the same manner in testing this specimen as for specimen 36T669-2. Since this specimen withstood 212 % of the design ultimate load without failure it was also tested for the hinge load condition.

Each specimen was loaded in increments of 10 % of the design ultimate load, and deflection readings taken after each load up to the design yield load. The design yield load was released and the specimen checked for permanent set. The load was again applied until reaching the design ultimate load and the specimen was examined after this load for indications of distortion or apparent failure. Loading was then continued until failure of the specimen occurred, except in the case of specimen 36T669-0.

**RESULTS:** Specimen 36T669-2 supported the design yield load of 7,650 # and withstood the design ultimate load; end fitting 36T671 failed in tension at the net section under a load of 12,700 #, 110 % of the design ultimate load of 11,500 #. See Figures 3, 4, and 5 for details of failure. No permanent set after the design yield load was noted.

Specimen 36T669-0 supported the design ultimate loads of 4,470 # up at the hinge and 8,210 # down at the lock with no indications of failure or serious distortion and withstood 212 % of the design ultimate load. The permanent set resulting from torque of the lock load recorded after application of design yield load was negligible, being approximately 1/32" down at the hinge. After releasing the 212 % load considerable distortion was noted in the steel tubes at the attachment points of the dummy steel lock bracket.

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Since specimen 36T669-0 did not fail under the 212 % load, the bracket was subjected to the hinge loading condition. The test resulted in failure at a load of 13,500 #, 116 % of the design ultimate load of 11,630 #, and was identical to the failure of specimen 36T669-2.

**DISCUSSION:** In view of the fact the  $\frac{1}{2}$ " hinge attachment bolts showed considerable bending it became apparent that failure was influenced by this condition. The fork fitting which failed in tension was designed on the assumption that the  $\frac{1}{2}$ " bolt loaded each prong of the fitting axially giving a stress at failure,  $P/A = 25,700$  psi. Material coupons from this fitting, however, indicated an allowable ultimate tensile stress of 51,000 psi.

The above differences in stress indicated a discrepancy in the basic assumption that the forks were axially loaded. An analysis based on a triangular distribution is shown on the succeeding page; the calculated maximum stress is 52,200 psi.

A comparison of this 52,200 psi stress with the material value of 51,000 psi obtained from test coupons of the actual fittings indicates that the assumption of triangular pressure distribution is conservative by approximately

$$\frac{52,200}{51,000} - 1 \times 100 = 2 \%$$

It was decided that if the above analysis is correct a larger bolt would change the distribution, reduce the moment, and result in a higher load at failure. Consequently an identical fitting to those tested and using an AN10 bolt rather than an AN8 was set up for a straight tension pull in the 200,000 # Southwark - Emery testing machine.

Failure of this specimen occurred as before and at a load of 25,750 #. Using 51,000 psi as an ultimate stress at failure and solving for the eccentricity it was found that the larger bolt reduced the eccentricity approximately 63 %.

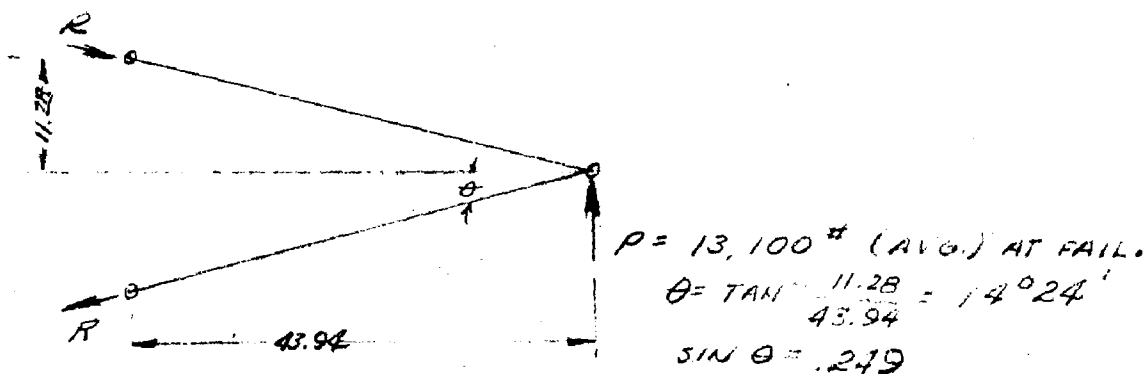
**CONCLUSIONS:** Both elevator hinge brackets exceeded the design ultimate loads for the conditions tested and are considered satisfactory. However, the type of failure indicates that:

- (1) The assumption that the end fitting bolts load each prong of the fork fitting axially is incorrect.
- (2) All magnesium fittings of Dow Ol-HTA or similar bar stock designed on the basis of this assumption should be re-investigated. Primarily this involves those fittings attaching the wing trailing edge to the rear spar fittings.

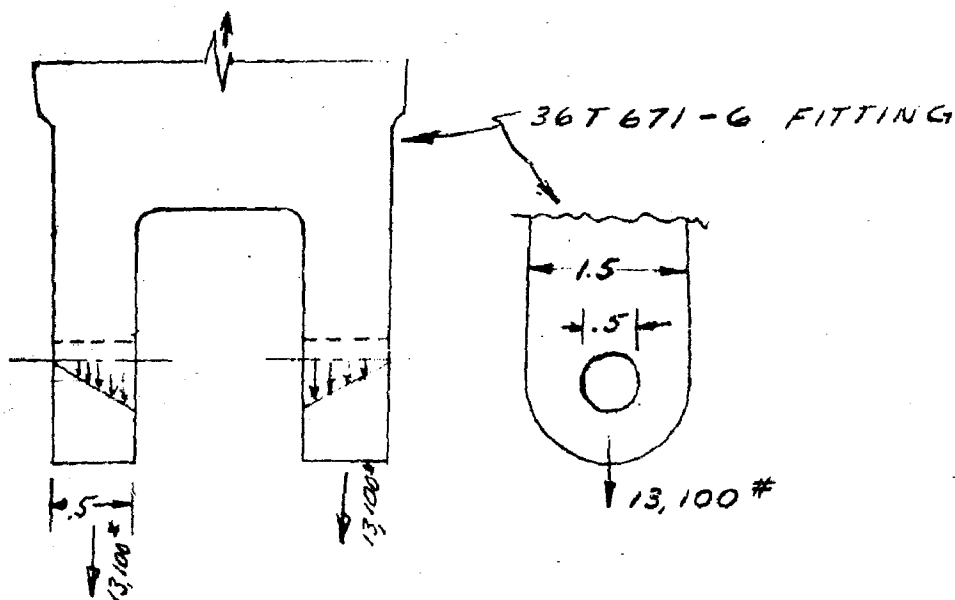
ANALYSIS TEST  
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 FORT WORTH, TEXAS

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 DATE 8-23-45



$R = \text{MEMBER LOAD} = \text{TENSION ON FITTING}$   
 $= \frac{13,100}{2 \times .249} = 26,200 \text{ # AT FAILURE}$



ASSUMING TRIANGULAR DISTRIBUTION OF 13,100 # LUG LOAD

$$\text{MAX. } f_c = \frac{P}{A} + \frac{My}{I} = \frac{13,100}{.5 \times 1} + \frac{13,100 \times .083}{\left(\frac{1 \times .5^3}{6}\right)}$$

$$= 26,200 + 26,000 = 52,200 \text{ P.S.I. AT FAILURE}$$



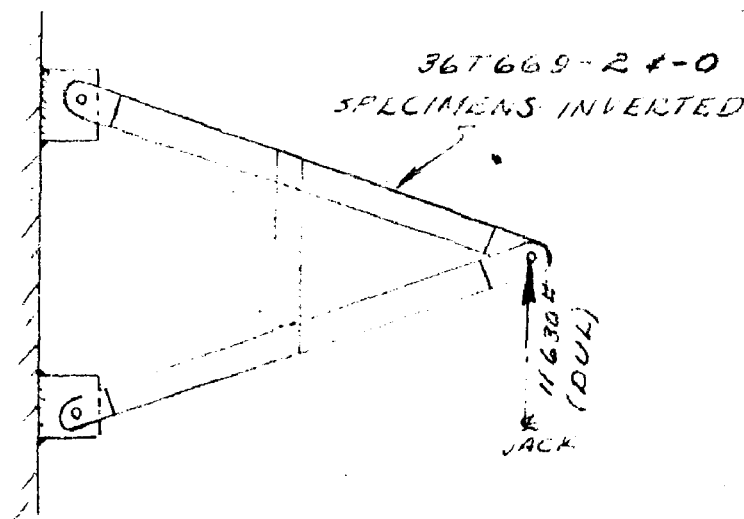


ANALYSIS TEST  
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 CHECKED BY \_\_\_\_\_  
 REVISED BY \_\_\_\_\_

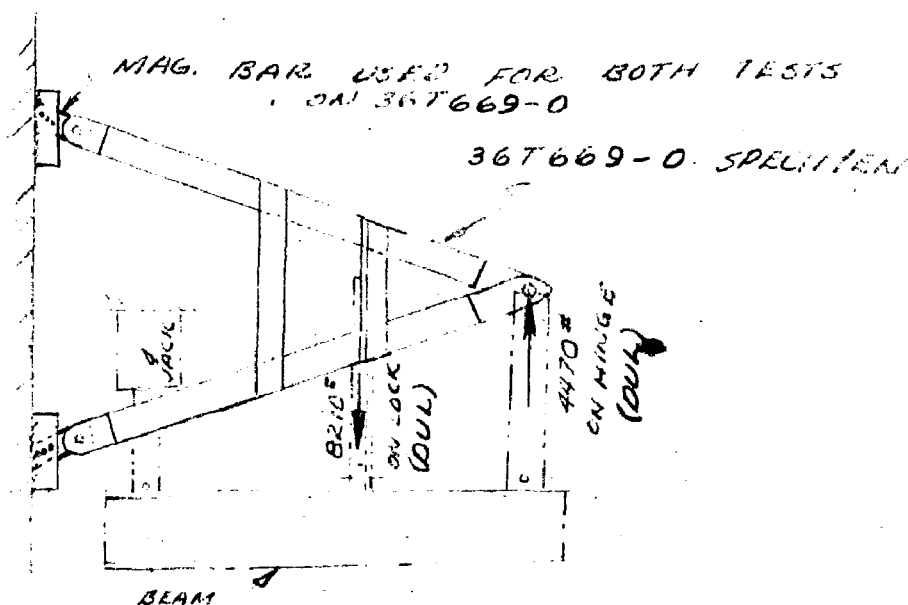
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 MODEL AB-5  
 DATE 8-23-45

FIG. 2

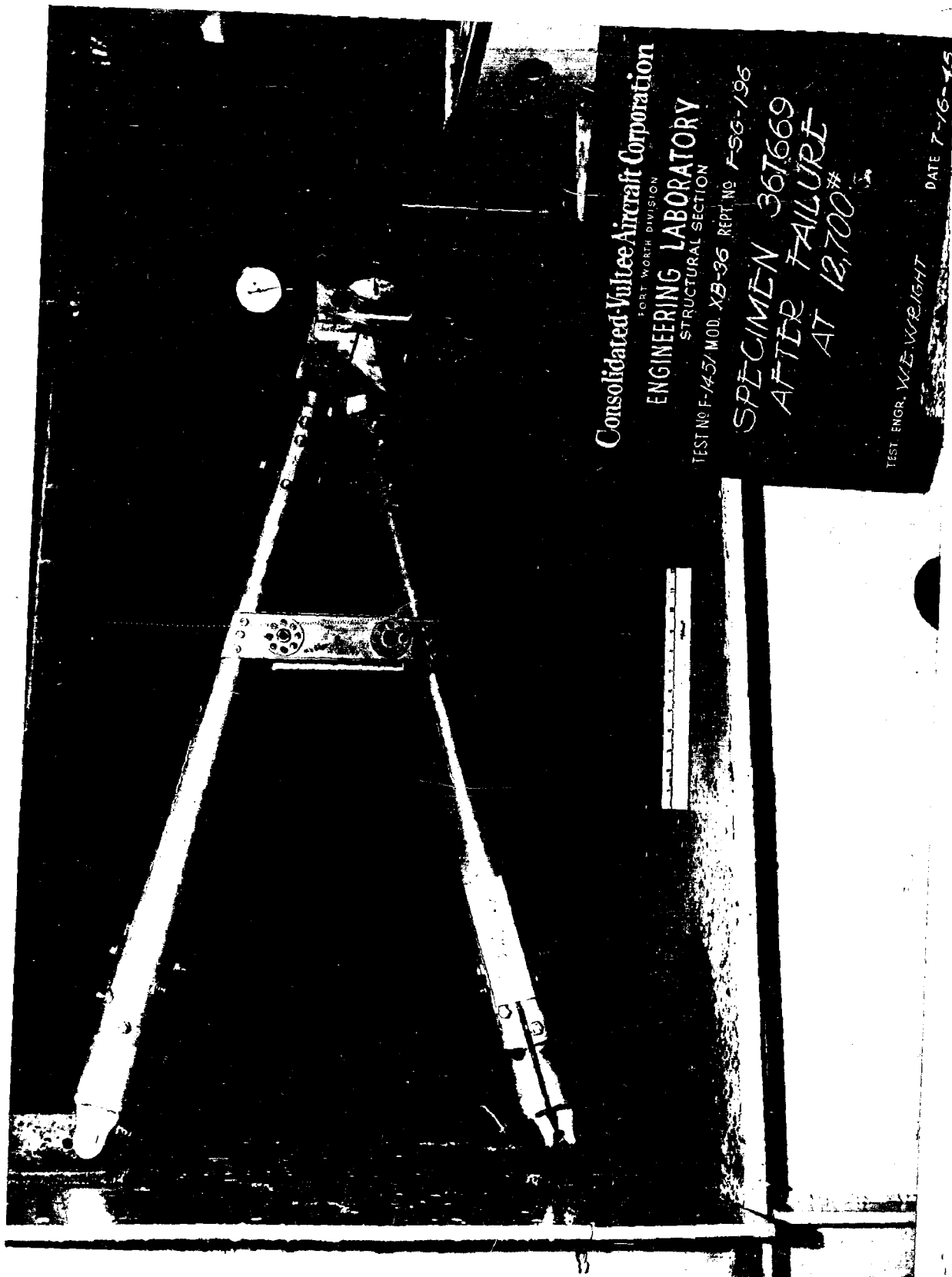


SET UP FOR L.A.H. COND.



SET UP FOR LOCKED COND.

FIGURE 2 - DIAGRAMS OF TEST SET UPS



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ENGINEERING LABORATORY

STRUCTURAL SECTION

TEST NO F-1457 MOD. XB-36 REPT NO F-56-196

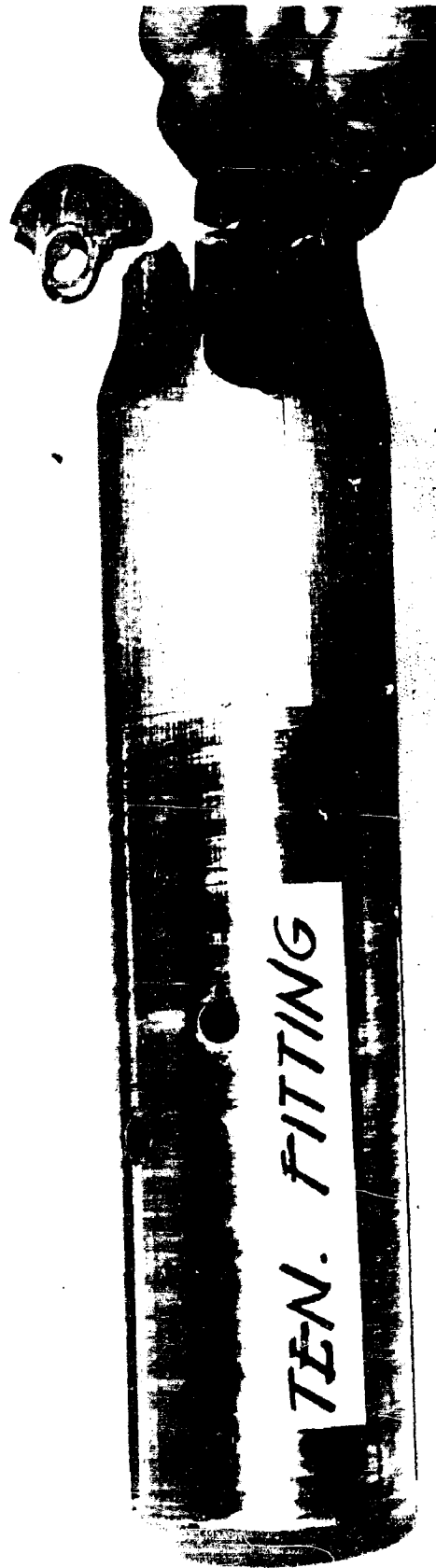
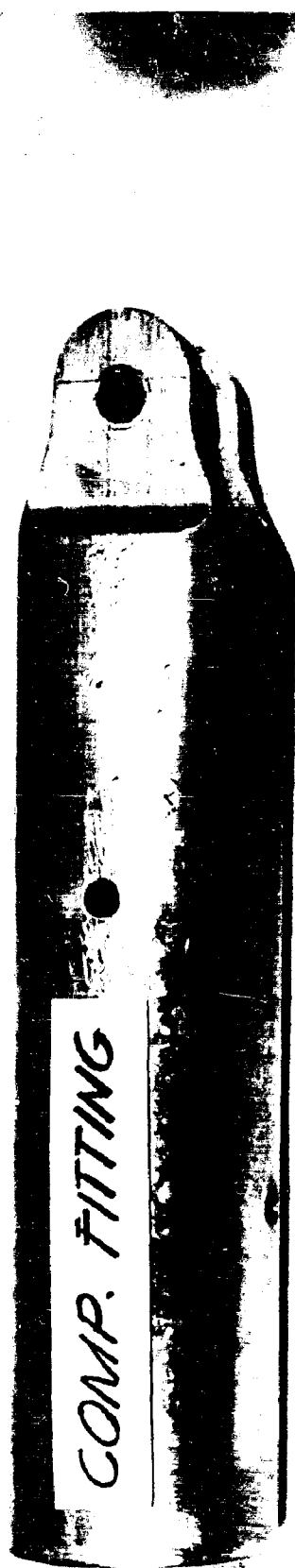
SPECIMEN 367669  
AFTER FAILURE  
AT 12,700#

TEST ENGR. W.E. WRIGHT

DATE 7-16-45

8

FIG. 3



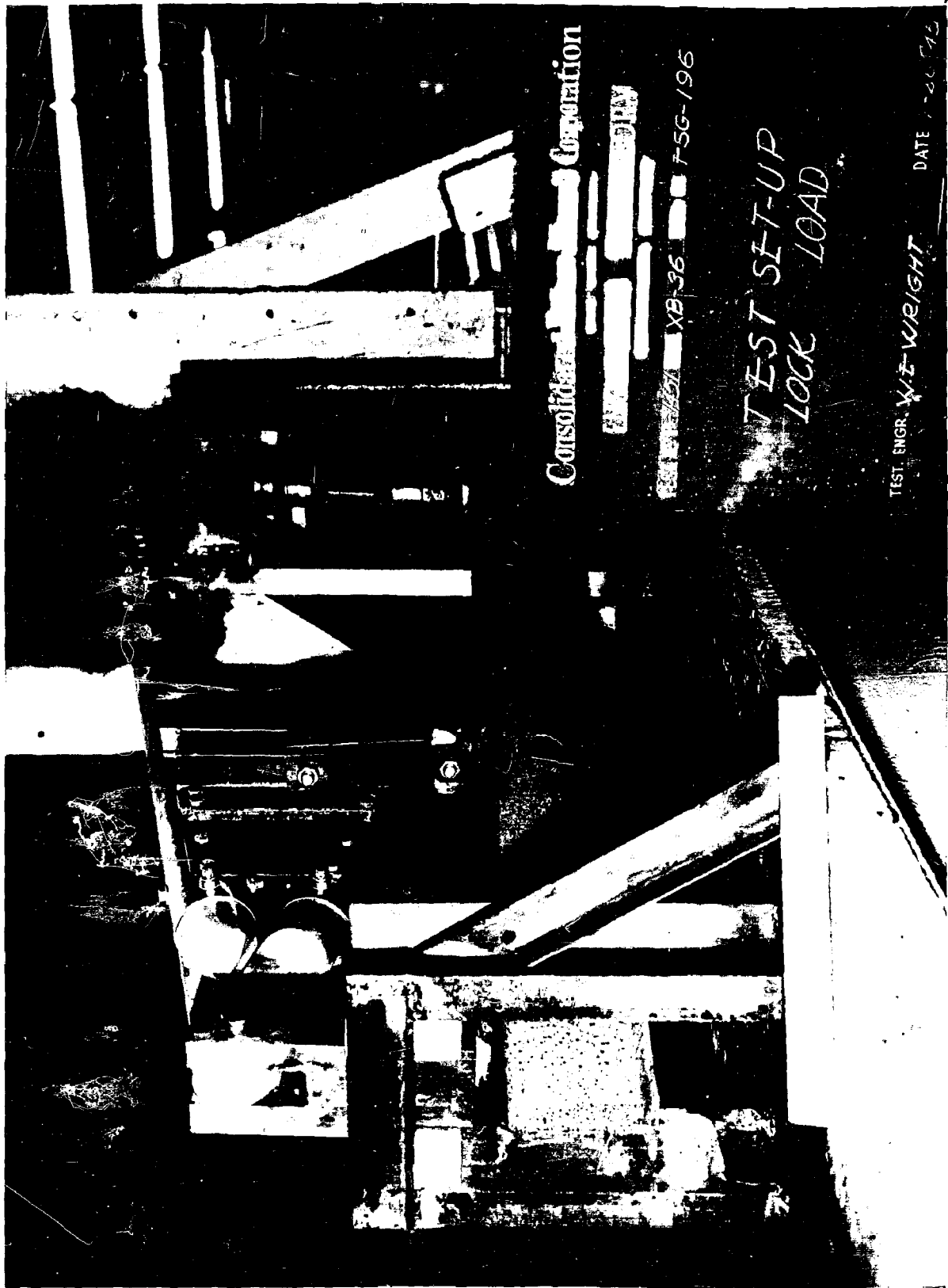
2-5089 7-17-45  
DETAIL-TENSION FAILURE  
END FITTING 36T671-6-  
MODEL XB-36-REPT. FSG-196.  
CVAC. FT. WORTH TEX.

FIG. 4



2-5088  
7-17-45  
DETAIL-TENSION FAILURE  
END FITTING 36T671-6-  
MODEL XB-36-REPT. FSG-196.  
CVAC. FT. WORTH TEX.

FIG. 5



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XB-36

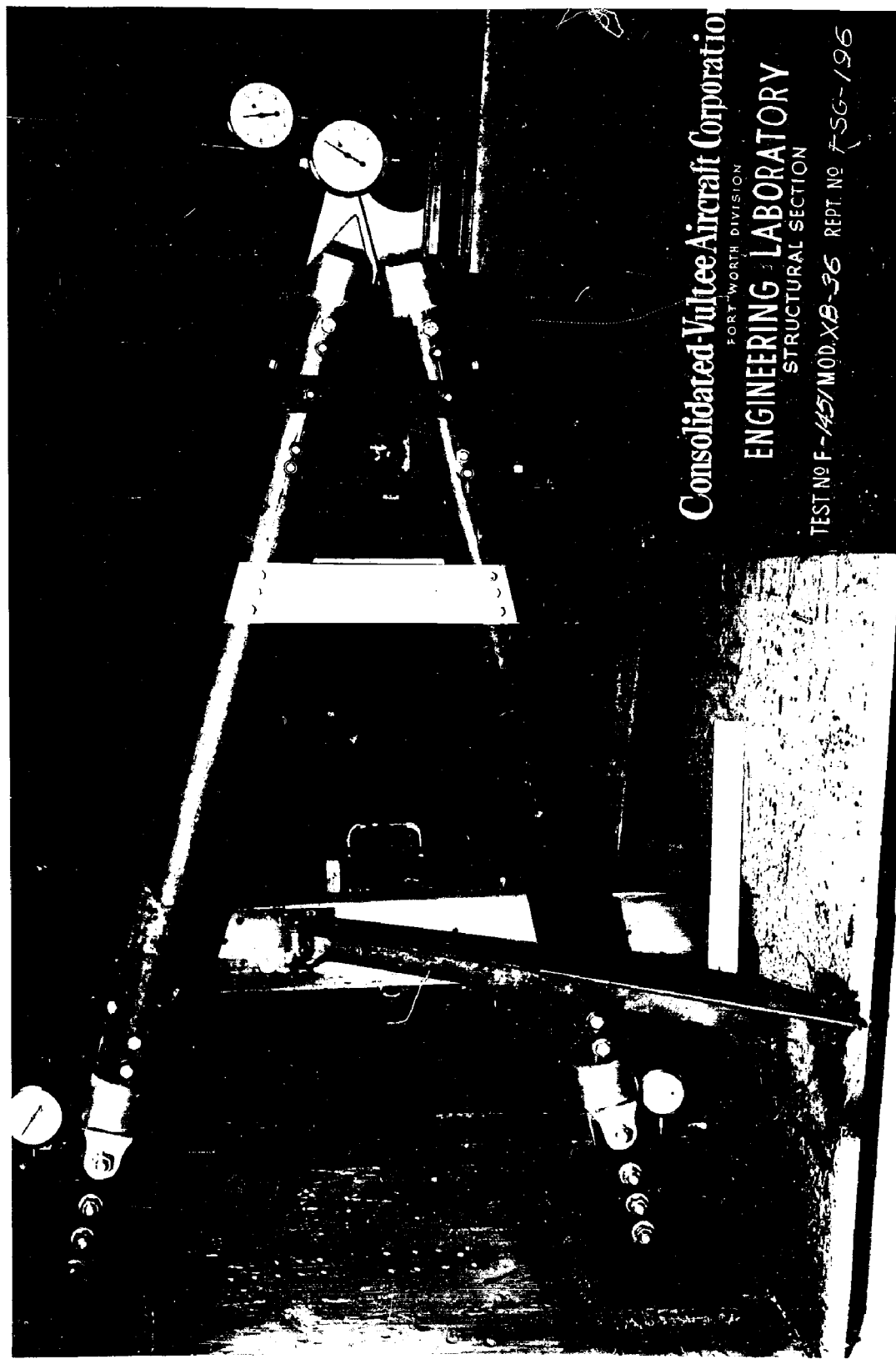
7-56-196

TEST SET-UP  
LOCK LOAD

TEST ENGR. W.E. WRIGHT

DATE 7-6-74

FIG. 6



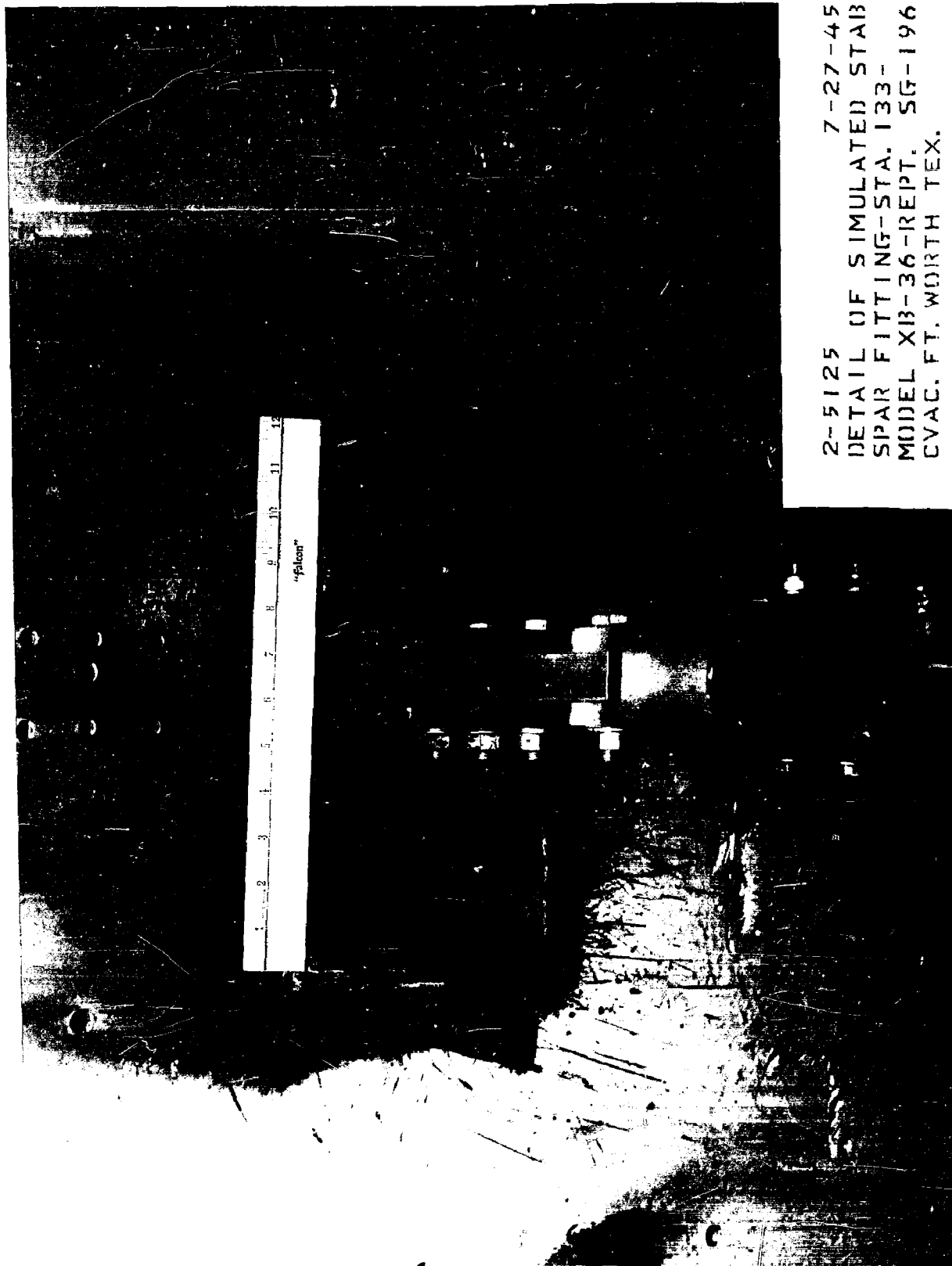
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STRUCTURAL SECTION

TEST NO F-145/MOD. XB-36 REPT. NO F-56-196

TEST SET-UP  
LOCK LOAD

FIG. 7



2-5125 7-27-45  
DETAIL OF SIMULATED STAB  
SPAR FITTING-STA. 133-  
MODEL XB-36-REPT. SG-196  
CVAC. FT. WORTH TEX.

FIG. 8

REEL - C

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